

KINEMATICS PROBLEMS

1. An airplane accelerates down a runway at 3.20 m/s^2 for 32.8 s until it finally lifts off the ground. Determine the distance traveled before take-off. **($1.72 \times 10^3 \text{ m}$)**
2. A car starts from rest and accelerates uniformly for 5.21 seconds over a distance of 110 m . Determine the acceleration of the car. **(8.10 m/s^2)**
3. Upton Chuck is riding the Giant Drop at Great America. If Upton free-falls for 2.6 seconds , what will be his final velocity and how far will he fall? **(-26 m/s , -33 m)**
4. A race car accelerates uniformly from 18.5 m/s to 46.1 m/s in 2.47 seconds . Determine the acceleration of the car and the distance traveled. **(11.2 m/s^2 , 79.8 m)**
5. On the moon, a feather is dropped from a height of 1.40 m . The acceleration of gravity on the moon is 1.67 m/s^2 . Determine the time it takes for the feather to fall to the surface of the moon. **(1.29 s)**
6. Rocket-powered sleds are used to test the human response to acceleration. If a rocket-powered sled accelerates to a speed of 444 m/s in 1.80 seconds , what is its acceleration and how far does it travel? **(247 m/s^2 , 400 m)**
7. A bike accelerates uniformly from rest to a speed of 7.10 m/s over a distance of 35.4 m . Determine the acceleration of the bike. **(0.712 m/s^2)**
8. An engineer is designing the runway of an airport. Of the planes which will use the airport, the lowest acceleration rate is 3.00 m/s^2 and the lowest take-off speed is 65.0 m/s . Assuming these minimum parameters are for the same plane, what is the minimum allowed length of the runway? **(704 m)**
9. A car traveling at 22.4 m/s skids to a stop in 2.55 s . Determine the skidding distance of the car. (Assume uniform acceleration.) **(28.6 m)**
10. A kangaroo is capable of jumping to a height of 2.62 m . Determine the take-off speed of the kangaroo. **(7.17 m/s)**
11. If Michael Jordan has a vertical leap of 1.29 m , what is his take-off speed and his hang time (total time to move upwards to the peak and then return to the ground)? **(5.03 m/s , 1.03 s)**
12. A bullet leaves a rifle with a muzzle velocity of 521 m/s . While accelerating through the barrel of the rifle, the bullet moves a distance of 0.840 m . Determine the acceleration of the bullet. (Assume uniform acceleration.) **($1.62 \times 10^5 \text{ m/s}^2$)**
13. A baseball is popped straight up into the air and has a hang-time of 6.25 s . Determine the height to which the ball rises before it reaches its peak. (Hint: the time to rise to the peak is one-half the total hang-time.) **(47.9 m)**

14. The observation deck of a skyscraper is 420 m above the street. Determine the time required for a penny to free-fall from the deck to the street below. **(9.26 s)**
15. A bullet is moving with a speed of 367 m/s when it enters a lump of moist clay. The bullet penetrates a distance of 0.0621 m. Determine the acceleration of the bullet while moving into the clay. (Assume uniform acceleration.) **($-1.08 \times 10^6 \text{ m/s}^2$)**
16. A stone is dropped into a deep well and is heard to hit the water 3.41 s after being dropped. Determine the depth of the well. **(-57.0 m)**
17. It was once recorded that a Jaguar left skid marks which were 290 m in length. Assuming that the Jaguar skidded to a stop with a constant acceleration of -3.90 m/s^2 , determine the speed of the Jaguar before it began to skid. **(47.6 m/s)**
18. A plane has a take-off speed of 88.3 m/s and requires 1365 m to reach that speed. Determine the acceleration of the plane and the time taken to reach the take-off speed. **(2.86 m/s^2 , 30.8 s)**
19. A dragster accelerates to a speed of 112 m/s over a distance of 398 m. Determine the acceleration of the dragster. (Assume uniform acceleration.) **(15.8 m/s^2)**
20. With what speed in km/hr must an object be thrown to reach a height of 91.5 m (equivalent to one football field)? Assume negligible air resistance. **(153 km/h)**